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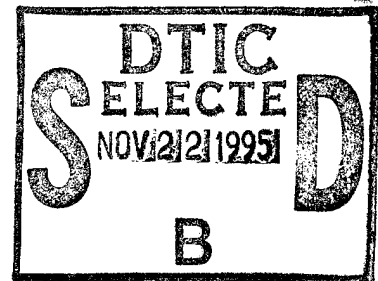


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THESIS

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**ANALYSIS OF THE RELATIONSHIP BETWEEN
RELIANCE ON GOVERNMENT BUSINESS AND
FINANCIAL CONDITION OF DEFENSE FIRMS**

by

Kevin Gerard Keith

June, 1995

Thesis Advisor:

O. Douglas Moses

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**ANALYSIS OF THE RELATIONSHIP BETWEEN
RELIANCE ON GOVERNMENT BUSINESS AND
FINANCIAL CONDITION OF DEFENSE FIRMS**

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Lieutenant, United States Navy, Supply Corps
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Submitted in partial fulfillment
of the requirements for the degree of

MASTER OF SCIENCE IN MANAGEMENT

from the

**NAVAL POSTGRADUATE SCHOOL
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TABLE OF CONTENTS

I.	INTRODUCTION	1
	A. THE OBJECTIVE OF THE STUDY	1
	B. SIGNIFICANCE OF THE STUDY	2
	C. SCOPE, LIMITATIONS, AND ASSUMPTIONS	3
	D. METHODOLOGY	5
	E. SUMMARY OF FINDINGS	7
	F. ORGANIZATION OF STUDY	7
II.	BACKGROUND	9
	A. GENERAL DESCRIPTION OF THE DEFENSE INDUSTRY	9
	1. National Security Concerns	11
	2. Political and International Affairs	11
	3. The Procurement Process	12
	4. Conclusion	14
	B. STUDIES ON RISK AND RETURN IN THE DEFENSE INDUSTRY	14
	1. Douglas Bohi - 1973	15
	2. Department of Defense Studies	16
	3. Willis R Greer, Jr. and Shu S. Liao - 1984	17
	4. Kenyon Kramer and John Morse - 1985	19
	5. Summary	21
	C. CONCLUSION	22
III.	METHODOLOGY AND DATA	25
	A. DATA	25
	1. Sample Firms	25
	2. Time Period	26
	3. Data Items	27
	B. MEASURES OF FINANCIAL CONDITION AND RELIANCE	28
	1. Financial Condition	28
	2. Reliance on Government Business	30

C.	METHODOLOGY	31
1.	Secondary Research Question #1	32
2.	Secondary Research Question #2	32
3.	Secondary Research Question #3	34
4.	Secondary Research Question #4	34
5.	Residual Analysis	35
D.	CONCLUSION	35
IV.	ANALYSIS	37
A.	SECONDARY RESEARCH QUESTION #1	37
B.	SECONDARY RESEARCH QUESTION #2	41
C.	SECONDARY RESEARCH QUESTION #3	44
D.	SECONDARY RESEARCH QUESTION #4	45
E.	CONCLUSION	46
V.	SUMMARY, CONCLUSIONS AND RECOMMENDATIONS	49
A.	SUMMARY OF RESULTS	50
B.	CONCLUSIONS	52
C.	RECOMMENDATIONS	54
	APPENDIX A. FREE MARKET VS. DEFENSE MARKET	55
	APPENDIX B. SAMPLE FIRMS	59
	LIST OF REFERENCES	63
	INITIAL DISTRIBUTION LIST	65

I. INTRODUCTION

This thesis will examine the relationship between a defense firm's reliance on government contracts for revenue and the financial condition (health) of the firm. Does a heavy reliance on government contracts tend to produce an unhealthy financial position for the firm? Or, is the situation completely reversed? Does any relationship exist at all? Has the nature of the relationship changed over time? The aim of this thesis is to determine if a relationship exist, and if so, document what that relationship is.

In the research, financial data from approximately forty defense firms will be analyzed. The period cover by the data is from 1983 to 1992. The amount of government business as a percentage of total revenue will be used to measure the firm's reliance on government contracts (independent variable). Various financial ratios developed from the firm's financial reports will be used to measure the financial health of the firm (dependent variables). Statistical test will be performed on the data to determine the relationship, if any, between the reliance on government contracts and the financial condition of the firms.

A. THE OBJECTIVE OF THE STUDY

The objective (and primary research question) of this thesis is to determine the relationship between a defense firm's reliance on government business and the financial condition of the firm. To answer the primary research question the following secondary research questions will be answered:

1. Is the financial condition of defense firms directly related to the amount of government business?
2. Given a change in the defense industry, is change in the financial condition of defense firms dependent on the amount of government business?

3. Did firms that changed their reliance on government business do better or worse than firms that didn't?
4. Do these previous relationships depend on whether the industry is in a period of increasing or decreasing defense spending?

The first question tries to determine if a relationship exist and what the relationship is. Questions 2 and 3 try to gauge the effect of reliance on the financial condition of the firm. Finally, question 4 attempts to determine if the relationship changes when overall defense spending changes.

B. SIGNIFICANCE OF THE STUDY

There are three possible results of this study. One, a heavy reliance on government business tends to promote a firm's financial condition. Second, a heavy reliance is inclined to reduce a firm's financial condition. Third, there is no relationship between reliance on government business and financial health. What do we hope to gain from determining which of these three results are correct? It depends on the answer.

If the results show a tendency for a heavy reliance to promote a firm's financial condition, then one should consider this result when calculating the amounts to be paid for defense items. Intuitively, one would think a healthy financial condition is based on profits. The more profits, the better off the firm is. Therefore, if defense firms who rely heavily on government business are generally healthier than other firms, then it is reasonable to assume the government is paying more than it should. It is not suggested that defense firms should not earn a profit. However, abnormally high returns, unless associated with higher risk, should be questioned.

On the other hand, if the study suggest that a heavy reliance tends to reduce a firm's financial condition, then

the situation should be explored to determine the causes of this association. The government places a number of requirements and limitations on its suppliers. More detailed accounting is required, additional inspections and reviews performed, and a host of reports prepared. There are significant costs associated with complying with these bureaucratic requirements. When the government signs a contract with a firm, the government's intent is to pay the cost incurred by the firm to produce the item plus a normal profit. Does the intent match reality? If the study suggest not, then the process may need to be examined in this light.

What if there is no relationship? After all there are a number of factors that affect the financial condition of a firm. It's possible that these factors negate the influence of government business. If so then government officials may not need to be greatly concerned with the financial condition of defense firms.

Once a relationship has been documented (if there is one), another question arises. Does the relationship remain constant during periods of increasing and decreasing defense spending? One would reasonably expect that during periods of increasing defense spending, a heavy reliance on government business would tend to promote a healthy financial condition, and during periods of decreasing defense spending, a low reliance on government business would predispose a firm to relatively better financial condition. If this is so, the awareness could aid government officials in developing its policy toward the defense industry.

C. SCOPE, LIMITATIONS, AND ASSUMPTIONS

The scope of the thesis is restricted to a statistical analysis of the relationship between the reliance on government business and financial condition of the firm. Revenue received from government contracts as a percentage of

total revenue will be used to measure a firm's reliance on government business. Financial ratios developed from a firm's published financial reports will be used as a measure of a defense firm's financial condition. The underlying hypothesis of this study is that a firm's financial condition is in part dependent on their reliance on government business for revenue. This study will compare firms with varying levels of reliance to determine what, if any, relationship exists. This approach was taken because it allows us to use numerical data and statistical techniques to answer the research questions. All other factors which effect a firm's financial condition will be disregarded in this study.

These "other factors" are a limitation on the research effort. A firm is neither healthy or unhealthy based on one factor. A firm neither succeeds nor fails for only one reason. A number of factors are usually at play. Upper management's policies, style, and abilities have a significant and direct impact on the financial condition of the firm. Current economic conditions can either promote or hinder financial condition. The political clout possessed by Congressmen and Senators from the firm's district can ensure continued demand for the firm's product even during a period of declining defense spending. All of these factors and many more affect the financial condition of defense firms. Unfortunately, for the most part there is no way to quantify or separate the impact of these factors. The effect of these "other factors" may cause differences in financial condition, which is not explained in terms of reliance on government business.

Another limitation is inflation. Inflation makes it difficult to compare figures over the course of time. Inflation understates the value of long term debt and fixed assets. A firm with old debt and fixed assets may look better than one with recently acquired fixed assets and long term debt. Some of the inflationary effects can be reduced by using

ratios vice actual numbers and by conducting analysis by year (i.e. if 10 years of data are collected then 10 test will be conducted for each ratio). These methods will reduce the inflationary effects, but will not completely eliminate them.

This study rest upon two assumptions. The first is that a firms reliance on government business can be measured by the percentage of total revenue that is received from government contracts. The larger the percentage, the greater the reliance. Since revenue is critical to a firm's continued operation, it follows that the larger the share of revenue received from one source, the greater the firm relies on that source for its continued operation.

A second assumption is that one can measure a firm's financial condition using financial ratios. Financial ratios are derived from accounting numbers published in annual financial statements. These accounting numbers are not cold hard facts. Instead, they are a mixture of facts gathered and judgements made (revenue recognition, cost allocation, depreciation methods, etc.) in accordance with generally accepted accounting principles. These judgements substantially affect the various account balances. Consequently, you could have the same condition in two firms but, due to different accounting policies, the reported condition (the amounts on the financial statements) could be quite different. Since the financial ratios are derived from the amounts presented on the statements, they to can vary. However, its assumed that financial ratios can serve as adequate measures of financial condition.

D. METHODOLOGY

The methodology employed will be a statistical analysis of data from secondary archives. The first step will be to define the sample and collect the data. In the second phase, measures of financial condition and reliance on government

business will be developed. The third phase will develop the hypotheses and tests to answer the research questions and conduct the actual test. In the final phase the results of the tests will be interpreted.

In defining the sample and collecting the data, what constitutes a defense firm will be determined first. Once guidelines are established, a sample of approximately 40 firms will be selected. Published financial statements for the years 1983 through 1992 will be collected for each firm. The required financial ratios will be developed from these statements.

Developing measures of financial ratios and reliance will be completed next. The framework for measuring financial condition will be developed from a review of literature and previous research on financial ratios. Based on the general knowledge of what financial ratios measure, plus the results of previous research using financial ratios, a tentative list of ratios to use will be developed. These ratios will be regressed against the percentage of total revenue from government contracts to determine if a relationship exists.

Using the percentage of total revenue received from government contracts as a measure of reliance on government business is intuitively the best measure of reliance. No other ratio would conceptually appear to be any better.

Least square regression and tests for differences between group means are the two statistical methods to be employed to answer the research questions. Linear regression will be used to establish if a relationship exist between reliance and a particular ratio for the first and third secondary research questions. The second secondary research question will be answered by dividing the sample into groups and performing tests of differences between group means. The fourth secondary research question will be answered based on the results of the test performed for the first three secondary research

questions. In each, the sample will be divided into two groups, the growth period (1983 to 1986) and the declining period (1987 to 1992).

E. SUMMARY OF FINDINGS

The level of reliance on government business does have a slight positive impact on the financial condition of defense firms. As the level of government business increases a firms profitability, asset utilization, and short term solvency improves. The relationship is strongest when defense spending is increasing, however, even then the relationship is very weak. Numerous other factors, besides the amount of government business, determines the financial condition of defense firms.

F. ORGANIZATION OF STUDY

The remainder of the thesis is divided into four chapters. In the next chapter, a description of the defense industry will be presented and then a review of prior research in the area of defense industry profitability and risk will be offered. In the third chapter, methodology employed and the data used will be further clarified. In the fourth chapter, the analysis of the results from the test performed will be presented. Finally, a summary of findings, conclusions reached, and recommendations developed will be offered.

II. BACKGROUND

Such procurement scandals as \$600 ashtrays and \$800 toilet seats have given the public the impression that defense firms earn abnormally high profits at the public expense. Additionally, huge cost overruns experienced by many procurement programs have had the same consequence. In response to these criticisms, a number of studies have been done to compare the risk and return in the defense industry with the civilian sector. These studies tried to determine if the risk involved and return received in the two sectors were the same or different. Higher returns in one sector could only be supported if the risk in that area was also higher.

In this chapter we will review the results of studies done since the early seventies. However, before the studies are discussed, a general description of the defense industry will be offered. The intent of this section to provide the reader with an understanding of the nature of the defense industry. In particular those aspects that make the defense industry more or less risky (aspects not present in the civilian sector) will be examined in some detail.

A. GENERAL DESCRIPTION OF THE DEFENSE INDUSTRY

The defense industry is a highly regulated monopsony. The sole buyer in the monopsony, the U.S. government, is also its regulator. The U.S. Government through its various agencies specifies what cost are allowed, how much profit can be earned, who will perform the work, how the accounting is to be done, how claims are settled, etc. Further, the government provides most of the money and much of the critical plant space and equipment. The heavy involvement of the government in the operation of the firms is one of the traits that separate the defense industries from other industries. The government has such a large role because the market is a

monopsony and not a free market. The forces of supply and demand do not determine what is to be produced, how much, and at what price. In the defense industry, the government has had to replace the market mechanism with an administrative mechanism. (Clayton, 1970, p 124)

In "The Economic Impact of the Cold War", James Clayton points out some of the differences between a normal commercial market and the defense market. In a normal commercial market the seller is the one who takes the initiative to produce the product and finances its development. Price is determined by the market, and competition within the market keeps prices reasonable and in line with risk, cost and other factors. However, in the defense industry it is the buyer who takes the initiative to develop a new product and provides the financing to support its development. Price is set by an administrative mechanism established by the government. In the normal commercial market the buyer has the option of purchasing a product from a number of sellers. In the defense market, the buyer, by taking such an active role in its development, has in effect already purchased the item. As you can see there are a number of differences between the defense industry and the commercial industries. (Clayton, 1970, pp. 120-121) Jacques Gansler in his book "The Defense Industry" list these and a number of other differences. They are reproduced in appendix A. (Gansler, 1980, pp. 30-31)

There is another difference that requires discussion: risk. The defense industry faces much of the same risk that commercial markets do. However, there are certain aspects of the defense industry that elevates or reduces risk in the industry. Three particular aspects that require further explanation are: national security concerns, the role of politics and international affairs, and the procurement process. Each are important because of the magnitude of their effect on risk.

1. National Security Concerns

There are some programs, industrial bases, that are so critical to national security that they are kept in business even when there is no current need for their product. Firms that build nuclear power aircraft carriers, nuclear submarines, military combat aircraft, and military track vehicles are some of the more prominent firms in this category (Kodghinson, p. 55). The story of the SEAWOLF program is a case in point. With the collapse of the Soviet Union and the Warsaw Pact, there was no need to build even one SEAWOLF class submarine. However, the United States had to retain some ability to produce nuclear submarines, so three very expensive SEAWOLF class submarines were built. More would have been built to keep the shipyard busy, but three were enough to carry the industrial base until the next generation submarine, the CENTURION class, was ready for production.

A firm which is the sole producer of one of these programs has significantly less risk. There may be some lean years at times, but the firm will not go out of business. The government will not permit it. Even if senior management makes a mistake and gets the firm into financial distress, the government will bail the firm out (two examples are Douglas Aircraft and Lockheed). So for firms like Electric Boat, the only builder of submarines, and Newport News, the only producer of nuclear aircraft carriers, the future is safe.

2. Political and International Affairs

On the other hand, politics and international affairs both reduce and increase risk in the defense industry. It is truly a double-edge sword. The annual budget process creates considerable uncertainty in defense programs [Gansler, 1980, p. 32]. Each year defense programs must justify themselves to Congress and run the risk of being reduced or eliminated. In fact, Wayne Martin reported in "An Empirical Assessment of Defense Contractor Risk, 1976-1984" that one

could use the variation in Department of Defense's (DOD) funding of research and development programs to serve as a suitable proxy for inherent program risk and demand variance (Martin, 1985, p. 123). The composition of Congress (Doves versus Hawks) can change and when it does, the direction of defense spending can also change. Likewise changes in foreign affairs can rapidly alter the industry. The end of the cold war is an example. In the mid 1980's there were about 120,000 firms in the defense industry. By the early 1990's there were only 30,000 (Smith, 1992, p. 89). All of these events are out of the defense industry's control and can significantly increase the risk of doing business in the defense industry.

The political aspect can help reduce the risk significantly. It is Congress who finally decides what the government will purchase, how many items it will buy, and how much will be paid. Congressional support for a firm's program can be exceedingly beneficial. It can protect a program and keep it going even during a period of declining defense budgets. Large defense firms sometimes sub-contract work out to firms in other Congressional districts in order to build support for their program. This is a highly effective strategy. One of the benefits of defense firms merging (assuming they are not located in the same Congressional district) is the two firms' Congressional support also merges (Gansler, 1980, p. 77). Consequently, the more support a program has in Congress, the less the risk faced by the firm.

3. The Procurement Process

The procurement process is an area where risk is high at one point in the process and low at another point. Risk declines when a company is awarded a development contract for a new weapon system. Since the firm that develops the program is usually the one who ends up producing the item, the firm is assured (almost) a source of revenue for a number of years. This substantially reduces the risk to the firm.

However, the firm must first win the development contract, and this achievement is extremely risky. Because in the defense industry there is "no share of the market" it's a winner take all situation (Gansler, 1980, pp. 33-34). If the firm is not awarded the development contract, then it has no market and must scramble to obtain another source of revenue. This situation results in a practice called "buy in".

"Buy in" occurs when defense firms purposefully bids low on a development contract in order to receive that contract. The firm is willing to risk taking a loss on the development contract in order to secure a sole source production contract. The firm's intention is to make up the loss on cost growth, additional charges on changes to the design made by the government, and the production contract itself. (Gansler, 1980, pp. 74-75)

Once a company buys in to a program, its risk is reduced considerably. Now that the firm has a long term source of revenue (10 to 20 years), its only risk now is to earn a profit. Risk is further reduced in that area because a power shift occurs between the defense firm and the government. Before the development contract is awarded, the government can coerce the defense firm to agree to stringent terms in the contract. The government can do this because of the other competitors for the development contract. However, once the development contract is awarded the power gradually shifts to the defense firm. By the time production begins, the defense firm is in a very powerful position in relation to the government. At this point in time, the government has now committed itself to the one firm. The government cannot start over with another firm. It would take years to develop another program, meanwhile the external military threat the system was design to meet has been or will soon be deployed. Additionally, the government usually cannot take the design to another company and have them produce it. A significant amount

of corporate knowledge is created during the development phase. This corporate knowledge cannot be communicated by drawings, documents, etc. The only firm that can reasonably be expected to be able to produce the item is the one who designed it. So at this point the defense firm is in a position to increase its profitability by going to the government with "explanations" of "government introduced" problems that are increasing cost, causing delivery delays, and so forth. The firm uses this tactic to bargain for increased price. In summary, risk is high until the firm is awarded a development contract but the risk is substantially reduced afterwards. (Gansler, 1980, pp. 78-79)

4. Conclusion

A general description of the defense industry has been offered. It is a unique industry that cannot be viewed from the same perspective one would view other industries. Certain aspects of the industry such as national security concerns, politics, international events, and the procurement process, elevates or reduces the risk faced by firm's in the industry. What has not been discussed so far is how well the defense industry has actually performed in comparison to firms in the civilian sector. That will be done in the next section.

B. STUDIES ON RISK AND RETURN IN THE DEFENSE INDUSTRY

A number of studies have been conducted on profitability and risk in the defense industry over the past several years. In this section we will review those studies. There are five of them and taken as a whole they cover the period 1960 through 1984. Each study attempts to measure profitability and risk in the defense industry and to compare the results to the commercial sector.

There are two difficulties in conducting this type of research. One, it's rare to find one firm which only produces for the defense market. Defense business is usually only a

portion of a firm's activities, and it is very difficult to measure the profitability of a portion (segment) of a firm. The second difficulty is that the studies have been conducted at various times. Competitive conditions change over time and new law and regulations are enacted. These events alter the situation from year to year and makes it difficult to make comparisons over time. (Greer and Liao, 1984, p. 24) With that said, the first study to be covered is one conducted by Douglas Bohi in 1973.

1. Douglas Bohi - 1973

In "Profit Performance in the Defense Industry", Douglas Bohi analyzed the performance of 36 defense firms during the period 1960 to 1969. All of the firms were taken from the DOD's annual list of "Top 100 Defense Contractors". Return on Net Worth was used by Bohi to measure profitability.

The first issue Bohi attempted to resolve was to see if the relative profitability of the sample of defense firms differed from profitability of manufacturing firms in general. From a comparison of the results it appeared that the defense firms were slightly more profitable. However, statistical test showed the performance was not significantly different. (Bohi, 1973, p. 725)

The second hypothesis tested was to see if there was a relationship between the percentage of total business attributed to government business and the profitability of the firm. The results of the study showed that there was no significant correlation between the two variables. 26 of the 36 firms in the sample registered a decline in the percentage of total business attributed to the government. Of the 26 firms, 11 had a declining profit rate and 15 had an increasing profit rate. 10 of the 36 firms in the sample registered an increase in the percentage of total business attributed to the government. Of the 10 firms, 3 had declining profit rates and 7 had increasing profit rates. Overall, the profit rate moved

in the same direction as the percentage of total business in 18 cases and moved in the opposite direction in the other 18. (Bohi, 1973, p. 726)

The final issue was to determine if profitability for defense firms had changed from the period 1960-64 to 1965-69 (i.e. did profitability change because of the Vietnam War). Profit rates for the defense firms did increase, but so did manufacturing profits in general. However, the increases were not significantly different between the two groups. (Bohi, 1973, p. 727)

The results of Bohi's research was profitability in the defense industry was not significantly different from profitability in manufacturing firms in general. One would surmise that if they are not significantly different, then they are roughly similar. As Bohi said in conclusion:

On the basis of the sample of 36 defense contractors considered here there is no evidence for arguing that defense business is any more or less profitable than non-defense business in general. (Bohi, 1973, p. 728)

2. Department of Defense Studies

In 1976 DOD sponsored a study called "Profit 76". The purpose of the study was to review DOD's profit policy and recommend changes. The study compared return on sales and return on total assets of defense contractors with the Federal Trade Commission durable goods manufacturers. The results showed the defense firms earned a smaller return on sales than the commercial activities but a higher return on total assets. Profit 76 concluded that pre-tax return on sales actually realized on government contracts was significantly less than what was negotiated by contracting officers. The study attributed the differences (and lower return on sales) to cost overruns. The study group believed the higher return on total assets was due to the lower capital investment required of

defense firms. The lower investment was because the government provided much of the equipment and plant space. (DOD, 1976)

In 1983 DOD sponsored a second study, the Defense Financial and Investment Review. This review continued the work of "Profit 76" by studying 1975 to 1983 data. The study concluded that from 1970 to 1979 profits for defense firms were comparable to ones earned in the durable goods manufacturers. Further, during the period 1980 to 1983 the average defense profits decreased slightly while profits of durable goods manufacturers dropped dramatically. The reason given for this difference was better defense firms performance (due to rising defense spending) and a decrease in inflation. (DOD, 1985)

3. Willis R Greer, Jr. and Shu S. Liao - 1984

In "A New Look at Risk and Profitability in Defense Contracting", Professors Greer and Liao examined risk and profitability in the defense industry. The objectives of their study were to answer the following three questions:

1. Is the profitability of DOD contracts influenced by the state of capacity utilization in the industry?
2. How profitable are the major aerospace contractors in their DOD versus commercial business segments?
3. Given the risk levels faced by contractors, is the return earned on DOD business equivalent to that earned on commercial work?

The analysis covered the period 1963 to 1982 and included approximately 25 aerospace firms. Profitability was measured by two ratios, return on sales and return on net worth. (Greer and Liao, 1984)

Greer and Liao concluded that defense contractor profitability was influenced by the state of capacity utilization. When utilization was low, profitability was also low. However, when utilization was high, profitability in the

defense industry approach compatibility with the commercial sector. The dividing line between the two was believed to be 80% capacity utilization. However, profitability would probably not reach parity until the 92.8% capacity utilization point was reached. Greer and Liao pointed out that at no time during the period under study did the aerospace industry reach that point. (Greer and Liao, 1984, p. 26)

In comparing profitability in defense versus commercial segments, Greer and Liao found that the average profit rate on defense business was lower than for commercial business. They regressed the firm's percentage of defense business (independent variable) against the two profitability measures (dependant variable). For return on sales the coefficient for the independent variable was negative for all 20 years. This indicated that defense business had a negative impact on return on sales. For return on net worth, 15 of the 20 years had a negative coefficient for the independent variable and the other 5 had a positive coefficient, However, the 5 were not statistically significant. (Greer and Liao, 1986, p. 1262) Using return on sales as the profitability measure, defense business return on sales ranged from 18.8% to 71.1% as high as the return on commercial business. Return on net worth for defense business ranged from 60.6% to 115% of the profit rate on commercial business. There was one period of three years where defense return on net worth exceeded the commercial segments. Greer and Liao attributed this exception to a revised profit policy (DPC 76-3) in effect during that time. (Greer and Liao, 1984, p. 25)

In their study of risk, Greer and Liao used three measures of risk: the standard deviation of return on net worth, the relationship between the Price Stability Index (PSI) and the percentage of total business attributed to the government, and the relationship of the firm's "beta" (a measure of the volatility of a firm's stock returns in

relation to the overall market) to the same percentage of government business. The results showed the standard deviation of return on net worth for defense work was 4.2% and for commercial work 3.2%. The disparity leads one to believe defense work is riskier than commercial work. Comparison of the PSI and the percentage of government business showed an inverse relationship, as the percentage increased, PSI would decrease and vice versa. This relationship also suggests that defense business is riskier. The results of comparing the firm's beta with the percentage of government business was not as clear. Betas for the defense firms were higher than the market averages but the magnitude of the beta was not related to the percentage of government business. (Greer and Liao, 1984, pp. 26-27)

In summary, Greer and Liao said:

The generally lower returns found for DOD business might be acceptable if the attendant risk were lower. However, none of the three risk measures used show DOD business to be less risky than commercial. (Greer and Liao, 1984, p. 26)

4. Kenyon Kramer and John Morse - 1985

In "DOD Contractor Profitability 1980 - 1984", Kramer and Morse compared DOD contractor profitability with the commercial segment. The data collected covered the period 1980 through 1984. They took a sample of 49 defense firms and compared their performance with the Fortune 500 average. The sample of 49 defense firms were divided into two groups. One group, composed of 36 firms, had government sales of less than 30% of total sales. The other group of 13 firms had government sales greater than 30%. Kramer and Morse used return on net worth as their measure of profitability.

Kramer and Morse first attempted to determine on an industry wide basis if the defense industry was more or less profitable than the commercial sector. Only the results of two

years were found to be statistically different. In 1983 all samples of defense firms (the groups of 49, 36, and 13) were more profitable than the Fortune 500. In 1984 the sample of 49 and 13, were more profitable than the Fortune 500. The sample of 36 was not. The results of the previous years, 1980 - 1982, were not statistically different. So at a macro level, defense business was as profitable or more profitable than the commercial sector. (Kramer and Morse, 1985, pp. 38 - 42)

Next, Kramer and Morse attempted to determine if there was a relationship between the percentage of total business received from defense and profitability. They regressed return on net worth against the percentage of defense business. The regression did not offer any strong results. Kramer and Morse concluded "there is little or no apparent relationship between the proportion of DOD sales and profitability". (Kramer and Morse, 1985, pp. 45-58)

Kramer and Morse next tried to assess whether defense firms faced more or less risk. To measure risk, Kramer and Morse used the standard deviation of return on net worth. The standard deviation of the sample of 49 firms was roughly equivalent to the Fortune 500 and the sample of 36 firms was similar. However, the variability of the returns for the sample of 13 firms was quite larger than the Fortune 500. In summary, Kramer and Morse concluded that when risk and return were compared there appeared to be no relationship between profitability and risk during this period. (Kramer and Morse, 1985, pp. 49-50)

At the micro level, Kramer and Morse compared the performance of the defense segments of firms with the other segments of the firms. Kramer and Morse took 11 of the 13 firms who had greater than 30% government business and divided the firm up into defense segment and non-defense segments. In these tests Kramer and Morse used operating margin as the measure of profitability. When the profitability of the

different segments were compared, it showed that the government segments consistently out-performed the commercial segments and the risk (standard deviation) for the government segments were lower. However, only in 1983 was the difference statistically different. Consequently, although defense business appears more profitable and less risky, there was no statistical proof it was so. (Kramer and Morse, 1985, pp. 61 - 67)

5. Summary

The results of much of the studies were inconclusive. Most statistical test performed did not show profitability and risk to be significantly different between defense and commercial sectors. Bohi concluded that defense business was not any more or less profitable than non-defense business. Profit 76 gave a conflicting story and the Defense Financial and Investment Review said defense performed better than durable goods manufacturers. Greer and Liao concluded that defense was less profitable and more risky than commercial sectors. Kramer and Morse showed defense to be generally more profitable and less risky but could only prove that point infrequently. So the results are mixed and confusing.

Part of the work done in these studies directly relates to the topic of this paper, comparing the percentage of total revenue derived from defense business with the financial condition of the firm. The aspects of financial condition measured in these studies were limited to profitability and risk. Bohi compared return on net worth with the percentage of defense business and found no correlation between the two. Greer and Liao regressed return on sales and net worth against the percentage of defense business. They found defense business had a negative impact of the two profitability measures. Greer and Liao also compared the percentage of defense business with the firms beta but

couldn't find a relationship between the two. Finally, Kramer and Morse regressed return on net worth against the percentage of defense business, but again could not find any correlation between the two. Once again the results are mixed.

C. CONCLUSION

Given what has been said before, the defense industry is not necessarily an attractive business to enter into. Why then do firms do so? Why do firms remain in the industry? A survey of corporate executives gave the following five reasons (listed in order of preference):

1. Government funding of research and development. Work done for DOD can sometimes be transferred to commercial products.
2. The large volume of business (in billions of dollars) gives the firm the image of being very large.
3. Provides the firm's managers an opportunity to manage a large, high-tech program.
4. The long term nature of defense programs. Once the firm is awarded a development contract they are assured of approximately 10 to 20 years of work.
5. Countercyclical balance for civilian business. (Gansler, 1980, pp. 41-43)

Greer and Liao added three other reasons:

1. The return on investment maybe higher for the defense firms because the government finances a portion of the investment.
2. The firm will try to shift as much of their overhead burden to the defense business. This will make their commercial segment more competitive.
3. The firm hopes to gain a marketing advantage. If they can produce a state of the art weapon system, then it must be capable of producing a very good commercial product. (Greer and Liao, 1986, p. 1266)

As one can see there is more to it than just profitability. One has to consider the impact of defense business on the firm's overall financial condition. That is what this study hopes to accomplish. In the next chapter, a framework will be developed to measure financial condition. Although risk and return will be important elements in the framework, they will not be the only attributes to be examined.

III. METHODOLOGY AND DATA

In this chapter the sample, measurements and statistical tests to be used will be discussed in detail. How firms were selected for the sample, the time period covered by the sample, and the particular information collected for each firm will be presented and justified. Next, the measurements used to represent financial condition and reliance on government business will be introduced and discussed. Finally, the statistical tests used to answer each secondary research question will be delineated. By the end of this chapter, one should have an understanding of the information and techniques used to answer the research questions of this thesis.

A. DATA

1. Sample Firms

The sample firms were drawn from a database of 50 defense firms available at the Naval Postgraduate School. These firms were initially extracted from the "Top 100 Defense Contractors for FY 1990" (Source: Directorate for Information Operations and Reports, Department of Defense, released 1991). The selection from this list was based on size and diversity. Since the defense industry is composed of a broad collection of sub-industries (aerospace, ADP, etc.), firms were selected to give an adequate representation of the various sub-industries. The largest defense contractors were selected based on total assets and net contract value.

Of the original list of 50 firms, only 37 will be used in this study. Twelve were deleted because the amount of defense sales could not be obtained. One, LTV, was deleted because it started the period in severe financial distress and remained that way for the entire period. Since the purpose of this thesis is to determine the relationship between financial condition and reliance on government business, a firm in such

condition would not be able to reflect such a relationship. Of the remaining 37 firms, 10 had only partial information on defense sales (data for some years were missing). These 10 firms will be included in the analysis for years when defense sales are present but will be ignored otherwise. Appendix B provides a list of the 37 firms in the sample, the years in which data is provided, and a list of the firms categorized by sub-industry.

2. Time Period

The time period selected for study is: 1983 through 1992. This period was selected because it was a time where defense spending both increased and decreased. An essential element of this study is to compare the relationship of financial condition and reliance between a period of growing defense spending and declining defense spending. For this thesis, the growth period will be 1983 - 1986 and decline 1987 - 1992.

The selection of 1986/1987 as the dividing line was based on Figure 1. Figure 1 is a graph of the budget authority and actual outlays for the Procurement and Research, Development, Testing, and Evaluation (RDT&E) appropriations (in constant FY 1995 dollars). Procurement and RDT&E appropriations were used to determine defense spending in the two periods vice total defense appropriations because these two most directly affect the defense industry. Budget authority was included because contracts could not be issued until the program was funded. Outlays were included because it identifies when the defense firms actually received payment. It's reasonable to assume that defense firms would recognize revenue somewhere between the two events, after funding is authorized but before payment is received. The point in time in which revenue is recognized is important in that it drives when sales and their associated cost are reflected in the income statement. It is at this point where one would want to

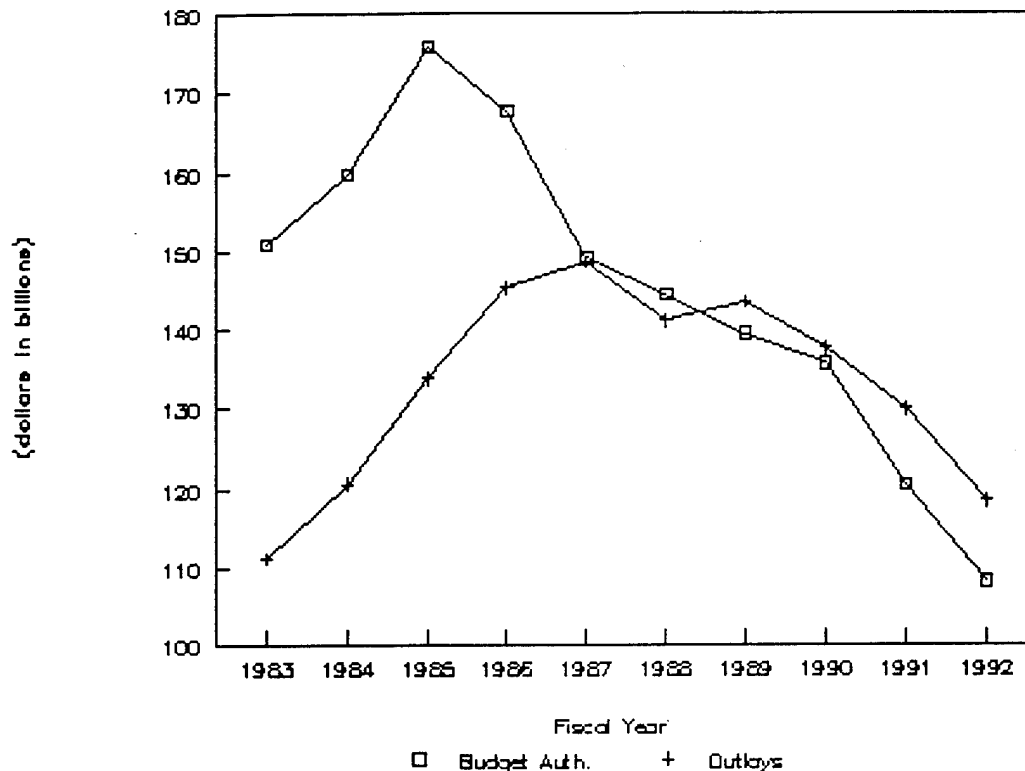


Figure 1. Procurement and RDT&E; 1983-92;
(constant FY 95 dollars)

measure whether the industry is growing or contracting; the point at which the state of the industry is reflected in the income statement. Based on this assumption, one would estimate the end point of the growth period to be between the year budget authority peaked (1985) and the year in which outlays peaked (1987). 1986 was selected as the end year of the growth period because it falls between the two peaks.

3. Data Items

The financial information on the defense firms in the sample were obtained from the firm's annual financial statements, the firm's 10K reports filed with the Securities and Exchange Commission, and Moody's industrial manual. These three sources provided a sufficient amount of financial data for analysis. The data items obtained were:

- Balance Sheet: Cash and marketable securities, Receivables, Inventory, Total current assets, Total

assets, Accounts payable and accrued expenses, Total current liabilities, Long term debt, Other long term liabilities, Total liabilities, Preferred stock, Retained earnings, and Total stockholders equity.

- Income Statement: Net sales, Total revenue from government, Cost of Goods Sold, Depreciation, amortization, and depletion expense, Total operating expenses, Net operating income, Interest Expense, Income tax expense, Total income from continuing operations, and Net Income.

B. MEASURES OF FINANCIAL CONDITION AND RELIANCE

1. Financial Condition

The financial condition of the firms in this study will be measured using a collection of financial ratios. Ratios are valuable tools in that they measure various attributes of a firm and reflect relationships between different accounts. They also facilitate comparisons between two or more firms, between a firm and an industry, and the performance of a firm over a period of time. These comparisons yield useful insights into a firm's condition and operations. Additionally, each ratio offers a different aspect of a firm's condition (profitability, asset utilization, solvency, etc.), and when taken as a whole, these various aspects should give one a fairly comprehensive view. For these reasons, a select group of financial ratios were deemed to adequately measure financial condition.

The group of ratios to be used in this study had to meet two criteria. One, each account appearing on the Balance Sheet and Income Statement had to be reflected in at least one of the ratios. The account could be either presented directly into a ratio (such as sales in total assets turnover) or included in a total or subtotal (such as cash in current assets). This was to ensure the ratios were comprehensive in terms of the financial statements. Secondly, all aspects of a firm's financial condition had to be addressed (such as

profitability, solvency, etc.). There are many ways in which to label these various aspects. However, for this study, the categories and labels developed by Pinches, Mingo, and Caruthers (1973) will be used. These labels are:

- Return on Investment
- Capital Intensiveness
- Inventory Intensiveness
- Receivables Intensiveness
- Financial Leverage
- Short-term Liquidity
- Cash Position

The categories and labels were derived from a study done by Pinches, Mingo, and Caruthers (1973) that classified ratios into groups that were highly correlated with one and another. Using Pinches, Mingo, and Caruthers classifications avoided redundancy in ratios chosen. Redundancy arises when two or more ratios measure the same aspect. An example is the current ratio and the acid test ratio. They both measure basically the same situation and are therefore highly correlated with one and another. Consequently, only one of the ratios needs to be employed. The use of Pinches, Mingo, and Caruthers classifications allowed the number of ratios to be kept small but at the same time represented almost all of the different facets of a firm's operation.

In a study completed by Pinches, Mingo, Caruthers, and Eubank (1975), specific financial ratios (two per classification) that most closely depicted the empirically defined financial ratio classifications were offered. Of these 14 ratios, one from each classification was chosen to measure financial condition in this study. These ratios are:

- Return on net worth
- Total asset turnover
- Inventory turnover
- Longterm debt/Total capital
- Receivables/Sales
- Current ratio
- Cash/Total assets

Two additional ratios were added, operating profit margin and return on total assets. These two ratios were added due to the criticality of profitability to a firm's financial condition. Problems elsewhere in a firm's operation can be overcome if a firm is very profitable. However, if a firm is not very profitable then no matter how well structured the firm is, it is in serious trouble. Therefore, additional perspectives of this area was desired. Operating profit and return on total assets provide the desired additional insights. Operating profit margin reflects the firm's ability to control cost and return on total assets indicates the firm's ability to earn a return on funds supplied from all sources. The addition of these two ratios is meant to add to the description of a firms return on investment provided by return on net worth so that a more detailed representation is obtained. The final framework for measuring financial condition is provided in Table 1.

2. Reliance on Government Business

The percentage of total sales that is received from government business will be used as a measure of a firm's reliance on government business. Since revenue is critical to a firm's continued operation, it follows that the larger the share of revenue received from one source, the greater the firm relies on that one source for its continued operation.

CLASSIFICATION	RATIO	FORMULA
Return on Investment	Return on Net Worth	$\frac{\text{Net Income}}{\text{Stk Equity-Pref Stk}}$
	Operating Profit Margin	$\frac{\text{EBIT}}{\text{Sales}}$
	Return on Total Assets	$\frac{\text{Net Income}}{\text{Total Assets}}$
Capital Intensiveness	Total Asset Turnover	$\frac{\text{Sales}}{\text{Total Assets}}$
Inventory Intensiveness	Inventory Turnover	$\frac{\text{COGS}}{\text{Inventory}}$
Receivables Intensiveness	Receivables/Sales	$\frac{\text{Receivables}}{\text{Sales}}$
Financial Leverage	Longterm Debt/Total Capital	$\frac{\text{TD} - \text{Current Liab}}{\text{TA} - \text{Current Liab}}$
Short Term Liquidity	Current Ratio	$\frac{\text{Current Assets}}{\text{Current Liabilities}}$
Cash Position	Cash/Total Assets	$\frac{\text{NI} + \text{Depreciation}}{\text{Total Assets}}$

Table 1. Framework for measuring financial condition

There may be other measures of reliance, but none appear to be conceptually more accurate than the percentage of total revenue. Using the percentage of total revenue gives us an objective, verifiable number that is supported conceptually as being a fair representation of reliance on government business.

C. METHODOLOGY

Least square regression and tests for differences between group means will be used to answer the research questions. In the following paragraphs the individual tests used to answer the secondary research questions will be specified. The final paragraph will discuss different methods used to ensure the regression models obtained during the testing are the most

appropriate ones (provide the best fit).

1. Secondary Research Question #1

Is the financial condition of defense firms directly related to the amount of government business?

Least square regression will be used to answer the first secondary research question. Each of the nine ratios will be regressed against the percentage of total revenue received from government business. Regression will be done for the entire sample (all 38 firms over the 10 year period, by the two periods of growth and decline (all 38 firms over the period 1983 - 1986 and again for 1987 - 1992), and finally for each year. The regressions covering the entire 10 year period and the two periods of growth and decline will be the principal regressions analyzed. The regressions done for each year will be used to elaborate on a specific situation or to resolve any possible confusion in the principal analysis. R^2 and the "P" statistic will be used to select the ratios that have a significant relationship with the percentage of total revenue that is received from government contracts.¹

2. Secondary Research Question #2

Given a change in the defense industry, is change in the financial condition of the defense firms dependent on the amount of government business?

To answer this question it will be necessary to divide the sample into two groups and perform separate

¹Outliers will be investigated to determine if they are valid (i.e. a negative return on net worth because stockholders equity is negative will be rejected). If the outlier is valid, then they will be brought in closer to the distribution curve to form the gradual ending slope of the curve. Their relative position will be maintained (the highest value will remain the highest value).

analysis for the two time periods (growth and decline in defense spending). The one group will be composed of those firms whose percentage of total revenue from government business is below 35% for the entire 10 year period and the other group will contain those firms whose percentage remains above 35% for the entire period. The 35% cutoff was selected for two reasons. One, a lower number is preferred because it minimizes the impact of government business on the firm. Secondly, the 35% cutoff provide two groups of roughly equal size. The below 35% group contained 16 firms and the above 35% group contained 14 firms. Seven firms in the sample could not be used in the sample because their percentage of government business ranged from below 35% to above 35%. The firms were grouped as follows:

- Firms above 35% government business: E-Systems, EG&G, General Dynamics, Grumman, Lockheed, Martin Marietta, McDonnell Douglas, Raytheon, Rockwell, United Industrial Corp., Computer Science Corp., Dynamics, Loral, and Northrup.
- Firms below 35% government business: General Electric, Honeywell, IBM, ITT, Johnson Controls, Morrison Knudsen, Olin, United Technologies, Westinghouse, Black and Decker, Eaton, Unisys, Motorola, Control Data, Hewlett-Packard, and Texas Instruments.
- Firms excluded: FMC, Gencorp, Teledyne, Harris, Boeing, TRW, and Harsco.

To measure the change in financial condition, the difference between a given ratio in one year and the same ratio in the previous year will be used. Next the average of the change in the ratio (separate average for each group) will be calculated for each year. The means of the two groups will be plotted to render an overall view of the situation. Additionally, "t" tests will be performed to determine if the means of the two groups (high and low reliance) are statistically different. Based on the plot and the "t" test,

sufficient information should be obtained to determine whether the change in financial condition of defense firms are dependent on the amount of government business.

3. Secondary Research Question #3

Did firms that changed their reliance on government business do better or worse than firms who didn't?

Least square regression will be used to answer this question. The change in a financial ratio (dependent variable) will be regressed against the change in percentage of total revenue (independent variable). The change will be measured by the difference between a given measurement from two points in time. These differences and subsequent regressions will be calculated in four sets:

1. 1992 measure less 1983 measure - to give an overall picture for the entire period.
2. 1986 measure less 1983 measure - to identify the relationship in a period of increasing defense spending.
3. 1992 measure less 1987 measure - to identify the relationship in a period of decreasing spending.
4. Lag the ratio and percentage measure by two years and lag the percentage two years behind the ratio (i.e. $\text{ratio}_{1987} - \text{ratio}_{1985}$ regressed against $\%_{1985} - \%_{1983}$) - permits one to measure the effect of a change in reliance on government business on subsequent periods.

Each regression will include all 37 firms. The four sets of regressions will be done for each ratio.

4. Secondary Research Question #4

Do these previous relationships depend on whether the industry is in a period of increasing or decreasing defense spending?

In the tests performed for the previous three

secondary research questions, a separate analysis will be conducted for each period (growth and decline). This will be done by dividing the sample into two groups (1983-86 data and 1987-92 data) and running the same tests as before. The results of the tests will be compared with one and another to determine if there is any difference.

5. Residual Analysis

One cannot accept the output of least square regression at face value. To ensure the regression model adequately depicts the actual relationships, residual analysis will be performed and various plots generated. The sample's dependent and independent variables will be plotted to identify the characteristic of the relationship (linear, curvilinear, etc.) The error terms will be plotted against the fitted value to check for constant variance in error terms and for any pattern not identified in the regression model. A histogram of the error terms and dependent variable will be obtained to ensure a normal distribution is present. Finally, the Durbin-Watson statistic will be obtained to check for independence in error terms. The use of these procedures should ensure the regression models derived from the tests are appropriate.

D. CONCLUSION

The objective of this thesis is to determine the relationship between a defense firm's reliance on government business and the financial condition of the firm. To determine the relationship, measures of reliance (percentage of total revenue) and of financial condition (nine select financial ratios) were developed. Financial data on a sample of 38 defense firms was obtained for a period that is divided between a period of growth and decline. The various aspects of the relationship have been captured in a set of four research questions. Appropriate statistical test for each research

question has been identified. Based on this framework, it is believed that the results of this study should give an adequate description of the relationship between reliance on government business and financial condition.

IV. ANALYSIS

This chapter will provide the results of the tests performed and an analysis of those results. The secondary research questions will be addressed in numerical order. Each secondary research question will be restated and a brief description of the test performed will be offered. Next, any statistically significant results will be presented and discussed. If any particular result is not mentioned, one can assume that the test were not significant. By the conclusion of this chapter the reader will know the outcomes of the tests and their implications, if any.

A. SECONDARY RESEARCH QUESTION #1

Is the financial condition of defense firms directly related to the amount of government business?

For secondary research question #1, each of the nine financial ratios were separately regressed against the percentage of total sales attributed to government business. Regressions were done for three different periods: the full sample (1983 through 1992), the growth period (1983 through 1986), and the declining period (1987 through 1992). The results were weak. Very few ratios proved to be related to percentage of government business. Of those that were related, the relationship was slight (low R^2 value) and some violated one or more of the assumptions of regression analysis - constant variance, normality inherent in error distribution, etc. Which suggest that the relationship may be exaggerated in its present form. Most of the ratios were unrelated to government revenue. Table 2 provides a list of the ratios that proved to be statistically significant (a significance level of .10 was used as a cutoff). The shaded boxes of Table 2 indicates those regression which were statistically

Time Period	Equation	R ²	P value
1983 to 1992	RONW=.06484+.09858(PCGB)	.0232	.0120
	ROA=.03093+.03718(PCGB)	.0274	.0062
	CAPTO=1.07164+.64845(PCGB)	.1322	.0001
	RECTO=.18961-.04586(PCGB)	.0369	.0014
	CURR=1.46690+.22807(PCGB)	.0152	.0419
1983 TO 1986	RONW=.07678+.13017(PCGB)	.0827	.0027
	ROA=.04624+.04043(PCGB)	.0375	.0455
	RECTO=.17368-.04928(PCGB)	.0801	.0031
	CAPTO=1.07415+.81760(PCGB)	.2555	.0001
	INVTO=4.43175+5.2353(PCGB)	.1093	.0005
1987 TO 1992	CAPTO=1.07301+.52301(PCGB)	.0790	.0003
	CURR=1.27084+.58586(PCGB)	.1238	.0001

Table 2. Results from Secondary Research Question #1.

significant but violated one or more of the assumptions of regression.

For the full sample, five ratios proved to be significantly related to government business: return on net worth (RONW), return on total assets (ROA), total asset turnover (CAPTO), receivables turnover (RECTO), and current ratio (CURR). However, with R² values of 0.0232, 0.0274, .1322, .0369, and .0152, respectfully, government business explains only a very small portion of the variance in these ratios. In addition, CAPTO, RECTO, and CURR ratios violated one or more of the assumptions of regression. All three lacked constant variance in the error terms. Plus, the error terms

for both CAPTO or CURR did not sum to zero. Finally, the error terms for CURR did not have a normal distribution. Operating income (OPINC), inventory turnover (INVTO), financial leverage (FIN), and cash position (CSHPOS) were not related to percentage of government business in this period.

For the growth period, five ratios proved to be statistically significant: RONW, ROA, RECTO, CAPTO, and INVTO. Although the R^2 values are higher, they are still too low to warrant much interest. Two of the five ratios, CAPTO and INVTO, violated one or more of the assumptions underlying regression (constant variance in error terms, sum of the error terms equal zero, and normality of error distribution). OPINC, CURR, FIN, and CSHPOS were not related to percentage of government business.

The results for the declining period were the most meager. There were two ratios significantly related to government business: CAPTO and CURR. However, both had low R^2 values and violated two assumptions of regression (constant variance in error terms and sum of the error terms equal zero). All of the other ratios were not related to percentage of government business.

Is there a relationship between a defense firm's financial condition and its reliance of government business? The results of these tests provide a mixed answer. Most of the regressions that were found to be statistically significant explained very little of the variation in the ratios (there is one exception). The low R^2 value associated with those regressions means the explanatory value of the independent variable (percentage of government revenue) is weak. Some other factor or factors, are responsible for much of the variation in the financial ratios. However, the regressions do provide some information of value.

The one exception mentioned above was CAPTO. This ratio was found to be statistically significant (at a level of .01)

in all three time periods. However, the fact that each of the CAPTO regressions violated one or more of the assumptions of regressions, tempers one's enthusiasm for this result. Nonetheless, its R^2 value was the highest R^2 value in two of the three time periods (.1322 in 1983 to 1992 and .2555 in 1983 to 1986) and its R^2 value (.079) for the other period (1987 to 1992) was "relatively" high. One explanation for this result is that the government provides much of the critical plant space and equipment to defense firms (Clayton, 1970, p.121). As a result, defense firms do not have to purchase as many manufacturing assets as a commercial firm would. Therefore, the asset base of defense firms are smaller which results in a higher CAPTO.

The sign of the coefficient provides an indication of the impact (positive or negative) of government business. The coefficient for all ratios in Table 1, except for RECTO, was positive. These means that as a defense firm increases its reliance on government business, these ratios also increase. In general, a firm is better off with these ratios increasing. RECTO had a negative coefficient which means that as the amount of reliance on government business increases, RECTO decreases. In general, a firm is better off with a lower RECTO ratio. Although the impact of government business is weak (low R^2 value) the sign of the coefficient show that as a firm's reliance on government business increases, the financial condition of the firm improves.

The absence of a relationship also tells us something. Three ratios, OPINC, FIN, and CSHPOS, did not show any relationship with the percentage of sales attributed to government business. This would lead one to conclude that the percentage of sales attributed to government business has no impact on a firm's OPINC, FIN, and CSHPOS.

B. SECONDARY RESEARCH QUESTION #2

Given a change in the defense industry, is change in the financial condition of defense firms dependent on the amount of government business?

To answer this research question, the sample was divided into two groups, those firms with revenue from government business less than 35% of their total revenue and those firms whose revenue from government business was greater than 35% of their total revenue. The differences between ratios in two successive years were taken and averages of the differences for each group were computed. A T-test was performed to determine whether the average change in the ratios were statistically different between the two groups at a significance level of 10%.

This procedure was performed to measure the change in the ratios from 1983 to 1986 and from 1987 to 1992. Only one ratio, CURR, in the 1987 to 1992 period, was statistically different. The greater than 35% group's CURR ratio increased by .41 while the less than 35% group CURR ratio decreased by .27. None of the other tests for these two periods were significant.

The procedure was also applied between successive years for the time period under study (i.e. 1983 to 1984, 1984 to 1985, etc.) Table 3 contains the averages computed for the change in the ratios between successive years. The shaded areas of Table 3 are the tests where ratio changes were determined to be significantly different between the high and low government business groups. Only 17% of the T-test performed proved to be statistically significant. Despite the small number of statistically significant results some information can be glean from the test.

If the average change in a ratio is not statistically different between the two groups, then one could consider them

	1983	1984	1985	1986	1987	1988	1989	1990	1991
	1984	1985	1986	1987	1988	1989	1990	1991	1992
RONW									
LT 35%	0.02	-0.12	0.03	0.07	-0.04	0.01	0.01	-0.16	0.08
GT 35%	-0.03	0.05	-0.10	0.04	0.01	-0.05	-0.01	0.03	-0.11
OPINC									
LT 35%	0.01	-0.04	0.01	0.02	0.01	-0.02	0.01	-0.03	0.01
GT 35%	0.00	0.01	-0.03	0.01	0.02	-0.03	0.01	0.00	0.00
ROA									
LT 35%	0.01	-0.05	0.01	0.02	-0.01	-0.01	0.01	-0.04	0.01
GT 35%	-0.01	0.01	-0.04	0.01	0.01	-0.02	0.00	0.01	-0.04
CAPTO									
LT 35%	0.05	-0.06	-0.03	-0.07	0.08	-0.04	-0.10	0.00	0.09
GT 35%	0.00	-0.07	-0.04	-0.15	-0.01	-0.04	0.01	-0.01	-0.03
INVT0									
LT 35%	-0.41	0.22	0.08	0.47	-0.06	0.67	-0.10	0.64	0.08
GT 35%	-0.89	-1.54	1.73	-0.93	-0.34	-0.33	0.57	0.64	0.26
RECTO									
LT 35%	0.00	0.00	0.00	0.03	0.00	0.00	0.00	-0.01	-0.01
GT 35%	0.01	0.01	0.00	0.02	0.01	0.00	0.00	-0.01	-0.01
CURR									
LT 35%	-0.02	-0.02	-0.15	-0.04	-0.05	-0.10	-0.03	0.02	-0.10
GT 35%	-0.14	0.01	-0.02	-0.01	0.29	-0.07	-0.01	0.16	0.04
FIN									
LT 35%	-0.02	0.00	0.03	0.07	0.01	0.06	0.01	-0.01	0.09
GT 35%	-0.01	0.02	0.05	0.04	0.00	0.00	0.00	-0.05	0.06
CSHPOS									
LT 35%	0.01	-0.05	0.01	0.01	-0.01	0.01	-0.01	-0.04	0.03
GT 35%	-0.01	0.01	-0.05	0.01	0.00	-0.02	0.00	0.01	-0.03

Table 3. Results from Secondary Research Question #2

as roughly equal. Therefore, one would conclude that a firm's degree of reliance on government business does not effect its financial condition as measured by such a ratio. None of the T-tests performed showed CAPTO, RECTO, and FIN ratios to be statistically different over any period of time included in the study. One could surmise that change in these ratios are not dependent in the amount of government business received by the firm.

One pattern of statistically significant results is present. There were three time periods in which four of the nine ratios were statistically different. In each case the ratios moved in the same direction (the group moved in the same direction). Specifically:

- 1984 to 1985: RONW, OPINC, ROA, and CSHPOS were all statistically different. For each ratio, the average for the greater than 35% group changed in a manner which improved the financial condition for those defense firms (if both ratios moved in a direction unfavorable to a firm's financial condition, the greater than 35% group changed less than the other group).
- 1985 to 1986: RONW, ROA, INVTO, and CSHPOS were all statistically different. For each ratio, the average for the less than 35% group changed in a manner more favorable to a firm's financial condition than the greater than 35% group.
- 1990 to 1991: RONW, OPINC, ROA, and CSHPOS were all statistically different. Like the 1984 to 1985 time period, these same ratios for the greater than 35% group changed in a manner more favorable to a firms financial condition than the less than 35% group.

One should keep in mind the data items included in the equations for these ratios. All of the ratios listed above are derived from the Income Statement. Net income is used to calculate RONW, ROA, and CSHPOS. EBIT and sales are used for OPINC. INVTO uses cost of goods sold in its calculations. What drives the amounts reported on the Income Statement is what

cost are matched with which sales and when these sales are recognized as current revenue. Therefore, one possible explanation for this pattern is the sales (and their associated costs) that were recognized as current revenue was significantly different between two groups for these time periods (i.e. large purchases of major weapons systems contracted for at the start of the buildup reached a point where the firms could recognize the revenue from these contracts)

Little of value was obtained from this secondary research question. A plot of the averages for the two groups were prepared (one plot for each ratio). However, there was no clear pattern present so the plots did not reveal any additional information. The three time periods discussed in the previous paragraph are interesting. However, due to the fact that this relationship exists for only three of the nine periods, it is not of much use.

C. SECONDARY RESEARCH QUESTION #3

Did firms that changed their reliance on government business do better or worse than firms that didn't.

Least square regression was used to answer this question. The difference in a financial ratio between two points in time was regressed against the difference in the firm's percentage of total revenue attributed to government business between two points in time. Four regression were done: 1992 less 1983 (the full sample), 1986 less 1983 (the growth period), 1992 less 1987 (declining period), and the full sample again except the change in the percentage of government business was lagged two years behind the change in the ratio (e.g. the difference in a ratio between 1985 and 1987 was regressed against the difference in percentage between 1983 and 1985). Thus, 36 regressions were run, one for each of the nine ratios, for

each of the four time periods.

Out of the 36 regressions performed only one ratio (i.e. the change in that ratio) proved to be related to the change in reliance on government business. The ratio was RECTO and the relationship existed for only one period of time, 1983 to 1986. The equation was:

$$\text{RECTO} = 0.011656 - 0.158678(\text{PCGB})$$

The R^2 was 0.1865 and the P value was .0447. The equation indicates that as a firm's reliance on government business increases, its RECTO decreases. Assuming all other factors remain constant a decreasing RECTO has a favorable impact on a firm's financial condition. However with a low R^2 value of 0.1865, the reliance on government business explains only a small part of the change in RECTO. With only one out of 36 regressions proven to be significant, it appears that changing a firm's reliance on government business had no systematic impact on a firm's financial condition.

D. SECONDARY RESEARCH QUESTION #4

Do these previous relationships depend on whether the industry is in a period of increasing or decreasing defense spending?

In each of the secondary research questions, specific tests were performed for the two different time periods (growth and decline). The weak results of the tests make it difficult to make comparisons between the two periods. However, one distinction did emerge. For any relationships identified, the relationships in the growth period were stronger and more frequent than in the declining period.

The findings from each secondary research question support this conjecture. In the first secondary research question, the growth period had as many or more relationships than any other period (full sample or the declining period)

and these relationships were stronger (higher R^2 value). The growth period had five regression models (two of which violated assumptions of regression), the full sample had five regression models (but three violated assumptions of regression), and the declining period only had two regression models (both of which violated assumptions of regressions). The R^2 values for the growth period were higher than both the full sample and declining period. It appears that the "relatively" strong relationship that existed in the growth period was reduced in the full sample because of the effect of the declining period. In the second secondary research question, three years had four of the nine ratios significantly different between the two groups. Two of the three were in the growth period and only one in the declining period. In the third secondary research question, the only relationship established occurred in growth period.

Although the justification is weak, the results of the tests seem to indicate that if a relationship between financial condition and reliance on government business exists, it is more apparent and stronger when defense spending is increasing. If one is to find a relationship, then it will more likely be found when defense spending is increasing as oppose to decreasing. The effect of reliance on government business, disappears or is minimal when defense spending declines.

E. CONCLUSION

Only 17% of all the tests conducted provided statistically significant results (at a significance level of 10%). Of the results that were significant, their explanatory value was minimal (low R^2 value). However, some useful information was obtained. Increasing ones' reliance on government business tends to have a favorable impact on some aspects of a firm's financial condition. CAPTO in particular,

is responsive to different levels of government business. The impact of a firm's reliance on government business tends to be stronger when defense spending is increasing. When defense spending is decreasing, the impact is minimal or nonexistent.

It is interesting to note that of the 162 tests performed, the FIN ratio was not related in any manner to reliance on government business. All of the other ratios, were related at one point or another. Therefore, one can assume that reliance on government business has no impact on a firm's financial leverage.

What does all of this mean? The purpose of this thesis has been to determine the relationship between reliance on government business and financial condition. This chapter has looked at particular aspects of a firm's financial condition in different circumstances. The next chapter will bring these various aspects together to see what overall impact reliance on government business has on a firm's financial condition.

V. SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

The objective of this thesis was to determine the relationship between a defense firm's reliance on government business and the financial condition of the firm. This relationship is important because the defense industry is as critical to the security of the United States as the armed forces are. It is the defense industry which provides the arms and other materials that enables the armed forces to fulfill their responsibilities. Therefore, it is in the country's best interest to ensure that transactions between the government and the defense industry are such that the financial viability of the defense firms are maintained. However, procurement scandals such as \$600 ashtrays and \$800 toilet seats as well as cost overruns on almost all major weapon system programs have given the public the impression that defense firms earn abnormally high profits at the public expense. On the one hand, the government should act as responsible stewards of the public treasury by not paying excessive amounts to obtain these arms. On the other hand, doing business with the government should not turn a defense firm into a pauper. If this were to be the case, then firms would leave the industry and the United States government would be without weapon suppliers. So does doing business with the United States government enhance or degrade a defense firm's financial condition?

This thesis was not the first attempt at answering this question. A number of studies were performed in the past comparing the risk and return in the defense industry with the commercial world. The results of these studies were mixed and confusing. Some showed that defense firms did better than commercial firms, some showed commercial firms doing better than defense firms, and others said there was no difference between the two. The primary difference between this study and

the previous ones is that this thesis tried to determine the impact of various levels of government business on the overall financial condition of the firms. The other studies restricted themselves to risk and return and comparisons with commercial firms.

To determine if a relationship between reliance on government business and financial condition of defense firms existed, data was collected from 37 defense firms over the period 1983 to 1992. This particular period was selected because there was both a period where defense spending was increasing and a period where it was decreasing. Nine ratios, representing almost all of the facets of a firm's operation, were selected to measure financial condition. The percentage of total sales attributed to government business was used to measure a firm's reliance on government business. Least square regression and tests for differences between group means were used to determine if any relationships existed.

A. SUMMARY OF RESULTS

The results of the tests were sporadic and weak. However, when a relationship was present, increasing levels of reliance had a positive impact on a defense firm's financial condition. In particular as reliance on government business was increased, profitability, asset utilization, and short term liquidity improved. Unfortunately, all of the regression models had a low R^2 value and many violated the assumptions inherent in regression analysis. In short, the impact of government business on the financial condition of a defense firm is considered to be positive but negligible.

Three other points should be discussed. One, R^2 values for the growth period were larger than R^2 values obtained from any other time period. This suggest that if a relationship exist between government business and financial condition, it is strongest when the industry is in a growth period. This

intuitively makes sense. Any firm in an industry that is growing will find its financial condition improving when its participation in that industry is growing as well. Second, the relatively high R^2 value for total asset turnover supports the assertion that government provides a significant portion of the critical plant and equipment required for production. This feature of the defense industry reduces the amount the firm has to invest and therefore increases the attractiveness of the defense industry to potential participants. Third, at no time was financial leverage shown to be related to reliance on government business. This lack of relationship leads one to conclude that a firm's capital structure is in no way related to its reliance on government business.

This lack of relationship permeates the results of the tests conducted for this thesis. What has been summarized so far are the few, weak relationships identified. Those relationships do not provide sufficient, convincing evidence that there is a relationship between reliance on government business and financial condition of defense firms. One might expect that firms highly dependent on government business to out perform those firms with a low reliance on government business during the growth period, and the opposite to occur when the declining period. However, the test did not offer convincing evidence to demonstrate this expectation as being true. One might also expected that if a firm changed its reliance on government business there would be a corresponding change in its financial condition, particularly when defense spending was growing or contracting. Only one of the 27 regressions performed showed any such relationship. Twenty-six others did not. The question was then asked if the impact of the change in reliance is reflected at a later point in time. Consequently, the change in reliance was lagged two years behind the change in the financial ratios, but these tests did not produce any relationships either. When taken in their

entirety, the tests performed simply do not provide sufficient, convincing evidence that reliance on government business has a direct or systematic impact on a defense firm's financial condition.

B. CONCLUSIONS

What is one to conclude from the findings, or more accurately, the lack of findings gleaned from the results of the tests? Well, one should conclude that the financial condition of a defense firm is determined more from "other factors" in its environment than its reliance on government business. These "other factors" constitute a wide variety of elements. Principle among them is the skills and abilities of the firm's senior managers. It is these people who can enable a firm to succeed by directing its activities away from unprofitable industries and toward those full of promise. The skills and abilities of the employees of the firm and the corporate culture in which they work are what makes a firm successful (when given proper direction from above). Patents, unique knowledge in a particular technology, and other core competencies play a crucial role in the firm's future as well. For defense firms in particular, the political clout possessed by Congressmen and Senators from the firm's district can be as instrumental as a new technological breakthrough. Positions in other markets and foreign military sales can also play a role. These are just a few examples of the wide variety of elements that are at play in determining the financial health of a defense firm. The level of participation in the defense industry can have a favorable impact on a firm's financial condition, but its impact pales in comparison to the impact of these "other factors".

Therefore, it is reasonable to conclude that doing business with the government doesn't necessarily make a company better or worse off. The robust financial health

fueled by "excessive" profits cited by defense industry critics are simply not present. Neither is poor financial condition caused by overly harsh government procurement policies. Defense industry is much like any other industry. If a firm can profit and improve its operation by entering the market it will, and as long as favorable conditions persist, the firm will increase its participation in the market. However, once the situation is reversed and participation in the industry becomes unprofitable or otherwise harmful to the firm's operation, then the firm will reduce its participation in the market or eliminate it altogether. The driving force behind these decisions is not the amount of government business, but all the other factors not addressed in this study.

During the defense draw down of the late 1980's and early 1990's there was considerable concern expressed about maintaining the defense industrial base. For those firms whose products had only one consumer, the Department of Defense, this fear was valid (unless of course it was the sole supplier of a critical weapon system). However, for the vast majority of defense firms this thesis showed the concern to be groundless. Reliance on government business has little impact on the financial condition of defense firms. Certainly a great number of changes occurred in the defense industry as the size of the market shrunk. The number of firms within the industry decreased and a large number of defense workers lost their jobs. However, the firms themselves did not disappear. Some left the industry, others reduced their defense segments, and others increased it. It is these "other factors" discussed earlier that determines whether a firm prospers or not. The chief among these being the ability of their senior managers to foresee the change in the defense industry, gauge the firm's ability to handle the changing market, and take appropriate, effective action.

C. RECOMMENDATIONS

However, one can not escape the conclusion that the degree of reliance on one customer for revenue can have a significant impact on a firms operation. However, this impact can not be seen in the financial condition of the firm. The impact is more likely to be on the internal operation of the firm. A defense firm has to adapt itself to deal with the unique aspects of the defense industry (monopsony, national security concerns, political and international affairs, procurement process, etc), considerations that normal commercial firms do not have to face. The use of a case study analysis would probably be a more effective way of ascertaining the impact of government business. Studying how two firms conduct business, one heavily concentrated in government business and another with only a incidental involvement in government business, would probably reveal more of the actual impact of doing business with the government than examining the financial condition of the firm. Obviously, defense firms have adapted themselves the unique aspects of the defense industry because they provided the same end result, a financially viable business.

APPENDIX A. FREE MARKET VS. DEFENSE MARKET

FREE- MARKET THEORY

Many small buyers.

Many small suppliers.

All items small, perfectly divisible, and in large quantities.

Market sets prices.

Free movement in and out market.

Prices set by marginal utility.

Prices set by marginal costs.

Prices fall with reduced demand.

Supply adjust to demand.

Labor highly mobile.

DEFENSE MARKET

One buyer (DOD).

Very Few, large suppliers of a given item.

One ship built every few years, for hundreds of millions of dollars each.

Monopoly or oligopoly pricing or "buy in" to "available dollars.

Extensive barriers to entry and exit.

Any price paid for the desired military performance.

Prices proportional to total cost.

Prices rise with reduced demand.

Large excess capacity.

Greatly diminishing labor mobility.

FREE-MARKET THEORY

Decreasing or constant returns to scale.

Market shifts rapidly to changes in supply and demand.

Market smoothly reaches equilibrium.

General equilibrium-assumes prices will return to their equilibrium value.

Profits equalized across the economy.

Perfect mobility of capital (money).

Mobility of capital (equip.) to changing demand.

No government involvement.

DEFENSE MARKET

Increasing returns to scale in region of interest.

7-10 years to develop a new system, then 3-5 years to produce it.

Erratic behavior from year to year.

Cost have been rising at approximately 5% per year (excluding inflation).

Wide and consistent profit variations between sectors; even wider between firms.

Heavy debt, difficulty in borrowing.

Large and old capital to equipment "locks in" companies.

Government is regulator, specifier, banker, judge of claims, etc.

FREE-MARKET THEORY

Selection based on price.

No externalities.

Prices fixed by market.

All products of a given type are the same.

Competition is for share of market.

Production is for inventory.

Size of market established by the buyers and sellers.

DEFENSE MARKET

Selection often based on politics, or sole source, or "negotiation"; only 8% of dollars awarded on price competition.

All businesses working for DOD must satisfy requirements of OSHA, EEO, awards to areas of high unemployment, small business set-asides, etc.

Most business, with any risk, is for "cost plus fee".

Essentially, each producers products are different.

Competition is frequently for all or none of a given market.

Production occurs after the sale is made.

Size of market established by "third party" (Congress) through annual budget.

FREE-MARKET THEORY

Demand sensitive to price.

Equal technology
throughout industry.

Relatively stable, multiyear
commitments.

Benefits of the purchase
go to the buyer.

Buyer has a choice of
spending now or saving for
a later purchase.

Source: (Gansler, 1980, pp. 30-31)

DEFENSE MARKET

Demand "threat"-sensitive,
or responds to availability
of new technology; almost
never price sensitive.

Competitive technologies.

Annual commitments, with
frequent changes.

A "public good".

DOD must spend its annual
congressional
authorization.

APPENDIX B. SAMPLE FIRMS

	<u>Data available for:</u>
1. McDonnell Douglas Corp.	1983 - 1991 only
2. Northrup Corp.	1984 - 1992 only
3. Lockheed Corp.	all 10 years
4. General Dynamics Corp.	all 10 years
5. General Electric Corp.	all 10 years
6. Raytheon Co.	all 10 years
7. United Technologies Corp.	all 10 years
8. Boeing Co.	1983 - 1989 only
9. Martin Marietta Corp.	all 10 years
10. Grumman Corp.	all 10 years
11. Loral Corp.	1985 - 1992 only
12. Rockwell International Corp.	all 10 years
13. Westinghouse Electric Corp.	all 10 years
14. TRW Inc.	all 10 years
15. IBM Corp.	all 10 years
16. Unisys Corp.	1984 - 1992 only
17. ITT Corp.	all 10 years
18. Texas Instruments Inc.	all 10 years
19. Olin Corp.	all 10 years
20. Computer Sciences Corp.	1987 - 1992 only
21. FMC Corp.	all 10 years
22. Teledyne Inc.	all 10 years
23. Johnson Controls Inc.	1989 - 1992 only
24. Motorola Inc.	all 10 years
25. Gencorp Inc.	all 10 years
26. Harris Corp.	all 10 years
27. Honeywell Corp.	all 10 years
28. Harsco Corp.	all 10 years
29. Black and Decker Corp.	1991 - 1992 only
30. EG&G Inc.	1983-88; 1990-92
31. E-Systems Inc.	all 10 years

	<u>Data available for:</u>
32. Morrison Knudsen Inc.	all 10 years
33. Dynamics Corp.	all 10 years
34. Control Data Corp.	1985 - 1992 only
35. Hewlitt-Packard Inc.	all 10 years
36. Eaton Corp.	1991 - 1992 only
37. United Industrial Corp.	all 10 years

Sample firms categorized by sub-industry:

- Ships: General Dynamics, Westinghouse, Unisys, Morrison Knudsen, General Electric, Lockheed, Raytheon, United Technologies Corp, and EG&G.
- Tank and automotive: General Dynamics, FMC, Harsco, Teledyne, and Johnson Controls.
- Aircraft: McDonnell Douglas, United Technologies, Lockheed, Grumman, General Dynamics, General Electric, Rockwell, Martin Marietta, Westinghouse, E-Systems, IBM, Raytheon, Teledyne, Black and Decker, Boeing Northrup, and Loral.
- Missiles: Raytheon, General Dynamics, McDonnell Douglas, Texas Instruments, Martin Marietta, Lockheed, Rockwell, General Electric, Gencorp, FMC, Westinghouse, Honeywell, EG&G, Olin, Northrup, Being, Motorola, and Loral.
- Training systems and services: General Electric, Raytheon, Unisys, McDonnell Douglas, General Dynamics, Lockheed, Honeywell, Grumman, Westinghouse, United Industries, Loral, and Boeing.
- Automatic data processing: Unisys, IBM, Honeywell, Eaton, Computer Science, Martin Marietta, McDonnell Douglas, Gencorp, and Harris, Control Data Corp, Hewlitt-Packard, and Loral.
- Electronics and Communications: IBM, Unisys, Martin Marietta, General Electric, ITT, Raytheon, Westinghouse, Honeywell, Eaton, TRW, Rockwell, Lockheed, Grumman, Harris, Computer Science, United Technologies, E-Systems, Teledyne, McDonnell Douglas, Boeing, Northrup, Loral, Motorola, Control Data Corp, and Hewlitt-Packard.

- Strategic defense initiative: McDonnell Douglas, Lockheed, Martin Marietta, General Electric, Grumman, Rockwell, TRW, Raytheon, IBM, Westinghouse, Honeywell, General Dynamics, Unisys, ITT, Gencorp, Texas Instruments, Teledyne, FMC, and EG&G.

Source: Military Forum, July/August 1988

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